

**REMARKS**

The present application was filed on December 18, 2001 with claims 1-21. Claims 1 through 21 are presently pending in the above-identified patent application. Claims 1-3, 12, 13, and 21 are proposed to be amended herein. Claims 5-8 are proposed to be cancelled herein, without prejudice. New claims 22-25 are proposed to be added.

In the Office Action, the Examiner required restriction of the claims under 35 U.S.C. §121 and objected to the drawings and abstract due to indicated informalities. The Examiner rejected claims 1-10 and 21 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner rejected claims 1, 2, 4-6, 8, and 21 under 35 U.S.C. §103(a) as being unpatentable over Bottomley (United States Patent Number 5,680,419 A), and further in view of Kanemasa et al. (United States Patent Number 4,730,343 A) and rejected claims 3, 7, 9, and 10 under 35 U.S.C. §103(a) as being unpatentable over Bottomley and Kanemasa et al., in view of Ghosh et al. (United States Patent Number 6,734,920).

The present invention is directed to a method and apparatus for performing joint equalization and decoding of multidimensional codes transmitted over multiple symbol durations. An RSSE scheme is disclosed that cancels the intrasymbol interference caused by other symbol components within the same multidimensional code symbol. The disclosed RSSE technique for multidimensional codes applies where the number of trellis code dimensions exceeds the number of channels. The disclosed RSSE decoder computes the intersymbol interference caused by previously decoded multidimensional code symbols and subtracts the intersymbol interference from the received signal. In addition, a branch metrics unit compensates for the intrasymbol interference caused by other symbol components within the same multidimensional code symbol. The disclosed RSSE decoder for 4D-TCM includes 2D branch metric units (2D-BMU) that calculate the 2D branch metrics for the two wire pairs based on the received 2D signals. The 2D-BMUs compensate for intrasymbol interference caused by other symbol components within the same multidimensional code symbol. In addition, the decision feedback unit (DFU) in the RSSE decoder processes the survivor symbols from the survivor memory unit (SMU) to calculate the intersymbol interference estimates

for all code states and channels, which are used by the 2D-BMUs to calculate the 2D branch metrics.

FIG. 6 has been amended to correct a typographical error. No new matter is introduced.

5                   Restriction Requirement

The Examiner required restriction of the claims under 35 U.S.C. §121 to one of the following inventions:

Group I: claims 1-10 and 21 drawn to a method for decoding a Multidimensional code; and

10                   Group II: claims 11-20 drawn to a Reduced State Sequence Estimation decoder for a Multidimensional code.

Applicants respectfully maintain the assertion that the restriction requirement is improper and should be withdrawn, since each Group is generally related to decoding multidimensional codes, and it is believed that a complete search for each Group would require a search of most, if not all, of the individual classes and subclasses. Accordingly, Applicants submit that an examination of both Groups would not impose a serious burden on the Examiner. Where, as here, “the search and examination of an entire application can be made without serious burden, the Examiner must examine it on the merits, even though it includes claims to distinct or independent inventions.” MPEP  
20                   §803.

Applicants further note that the independent method claim 1 and independent apparatus claim 11 have a significant number of corresponding limitations. Accordingly, it is respectfully requested that the restriction requirement be reconsidered and withdrawn and that all of the pending claims in the application be examined together in this application. Alternatively, Applicants respectfully select Group I, claims 1-10 and  
25                   21, for prosecution on the merits and withdraw claims 11-20, corresponding to Group II from prosecution.

Section 112 Rejections

Claims 1-10 and 21 were rejected under 35 U.S.C. §112, second  
30                   paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claims 1 and 21, the

Examiner asserts that it is not clear whether “the same multidimensional code symbol” refers back to a previously decoded multidimensional code symbol recited in lines 3 and 4 in claim 1 (lines 2 and 3 in claim 21), or to a currently received symbol. Regarding claim 5, the Examiner asserts that the limitation “said initial symbol duration is not  
 5 affected by intrasymbol interference” in lines 3 and 4 is indefinite since it is a negative limitation and has no structural impact. Regarding claim 6, the Examiner asserts that the limitation “wherein said subsequent symbol durations are affected by intrasymbol interference” in lines 3 and 4 is indefinite since it does not indicate a structural change in the decoder of claim 1.

10 Independent claims 1 and 21 have been amended to emphasize that the compensation is for intrasymbol interference caused by symbol components within the current multidimensional code symbol.

Claims 5 and 6 have been cancelled. New corresponding claims 22 and 23 have been added, consistent with the Examiner’s suggestions regarding a negative  
 15 limitation that has no structural impact (previous claim 5) and a limitation that does not indicate a structural change in the decoder of claim 1 (previous claim 6), as discussed below.

Applicants believe that these amendments address the Examiner’s concern Applicants respectfully request that the rejections of the claims under section 112 be  
 20 withdrawn.

#### Formal Objections

The drawings were objected to because handwriting is smudged in places and because the reference characters ‘400’ in FIG. 4 were not mentioned in the specification.

25 Applicants note that formal drawings were previously submitted on March 25, 2002. Applicants are resubmitting herewith five (5) sheets of formal drawings with the reference characters ‘400’ in FIG. 4 deleted and respectfully request that the objections to the drawings be withdrawn.

The Abstract was objected to because it exceeds 150 words in length.

30 The Abstract has been amended to be less than 150 words in length and Applicants respectfully request that the objections to the Abstract be withdrawn.

Independent Claims 1 and 21

Independent claims 1 and 21 were rejected under 35 U.S.C. §103(a) as being unpatentable over Bottomley, and further in view of Kanemasa et al.

Regarding claims 1 and 21, the Examiner acknowledges that Bottomley  
5 does not explicitly teach the specific use of compensating for intrasymbol interference caused by symbol components within the same multidimensional code symbol, but asserts that Kanemasa discloses this limitation (last sentence of Abstract).

Applicants note that Bottomley does not teach a method for decoding a multidimensional code symbol, but discloses a method for estimating signals that are  
10 received using multiple antennas, where each received signal is corrupted by fading, time dispersion and interference. Bottomley does not teach that the transmitted signal comprises multidimensional code symbols. Therefore,  $[r_a(n), r_b(n), r_c(n)]$  are not multidimensional code symbols, but are signals received by 3 antennas for the same transmitted signal. As the Examiner acknowledges, since Bottomley does not teach using  
15 a decoder to decode multidimensional code symbols, Bottomley does not disclose intersymbol interference caused by previously decoded multidimensional symbols.

Applicants also note that Kanemasa does not teach to compensate for intrasymbol interference caused by symbol components with the same multidimensional code symbol. Kanemasa only teaches to estimate intrasymbol interference caused by the  
20 current pulse shape at times  $2/4T$  and  $4/4T$ . Kanemasa does not consider multidimensional code symbols nor intrasymbol interference caused symbols components within the same code symbol. Independent claims 1 and 21, as amended, require compensating for intersymbol interference caused by previously decoded multidimensional code symbols; and compensating for intrasymbol interference caused  
25 by symbol components within a same multidimensional code symbol.

Thus, Bottomley and Kanemasa et al., alone or in combination, do not disclose or suggest compensating for intersymbol interference caused by previously decoded multidimensional code symbols; and compensating for intrasymbol interference caused by symbol components within a same multidimensional code symbol, as required  
30 by independent claims 1 and 21, as amended.

### Dependent Claims 2-10

Dependent claims 2, 4-6, and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over Bottomley, and further in view of Kanemasa et al. and claims 3, 7, 9, and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Bottomley and Kanemasa et al., in view of Ghosh et al.

Claims 2-4 and 9-10 are dependent on claim 1 and are therefore patentably distinguished over Bottomley, Kanemasa et al., and Ghosh et al. (alone or in any combination) because of their dependency from amended independent claim 1 for the reasons set forth above, as well as other elements these claims add in combination to their base claim. In addition, Applicants note that Bottomley does not teach that the components of one multidimensional symbol are transmitted over more than one signal interval associated with said component, as required by claim 2. Bottomley does not teach that the components of one multidimensional symbol are transmitted over more than one signal interval associated with said component (see claim 2).

Regarding claim 3, Ghosh does not teach using a multidimensional code with dimensions that exceeds a number of available channels. Instead, Ghosh teaches to use a plurality of trellis codes, which are interleaved.

### New Claims:

New claims 22-25 have been added to more particularly point out and distinctly claim various features of the invention, consistent with the scope of the originally filed specification, in order to give applicant the protection to which he is entitled. No new matter is introduced. The Examiner has previously considered portions of the subject matter presented in new claims 22-25 when rejecting cancelled claims 5-8. More specifically, new claim 22, based at least in part on original claim 5, emphasize that the initial symbol duration is a *portion of the multiple one-dimensional symbol duration sequence* not affected by intrasymbol interference. Similarly, new claim 23, based at least in part on original claim 6, emphasizes that the subsequent symbol durations are portions of the multiple one-dimensional symbol duration sequence affected by intrasymbol interference.

New claims 22-25 are dependent on claim 1 and are therefore patentably distinguished over Bottomley, Kanemasa et al., and Ghosh et al. (alone or in any

combination) because of their dependency from amended independent claim 1 for the reasons set forth above.

Allowance of claims 22-25 is believed to be warranted.

It is noted that Applicants have traversed the restriction requirement above and strongly request reconsideration by the Examiner. In the event the Examiner allows prosecution of the claims of Group II in the present application, Applicants wish to add similar dependent claims to new claims 22-25 that would depend from claim 11.

Conclusion

All of the pending claims, i.e., claims 1-4 and 9-25, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

The Examiner's attention to this matter is appreciated.

Respectfully submitted,



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IN THE DRAWINGS:

Please amend FIG. 6, as indicated on the attached marked-up copy of original FIG. 6. No new matter is introduced.